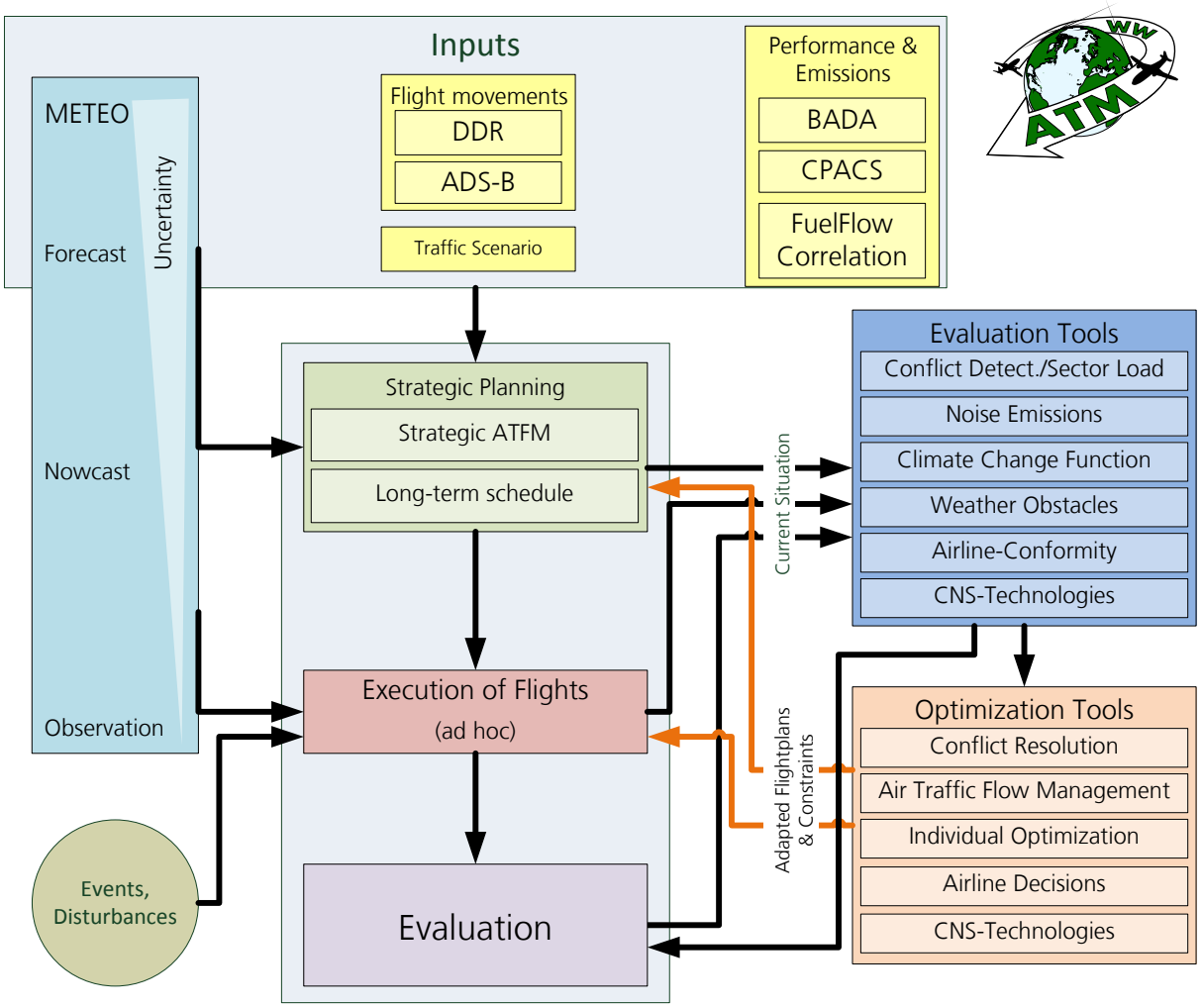
Optimization without Limits – The World Wide Air Traffic Management Project

Author: **Alexander Kuenz**
Affiliation: **Institute of Flight Guidance, DLR Braunschweig, Germany**
Mail: **Alexander Kuenz**
Lilienthalplatz 7
38108 Braunschweig
Germany
Telephone: **+49 531 295-3008**
Fax: **+49 531 295-2550**
E-Mail: **Alexander.Kuenz@dlr.de**

Abstract

In air traffic management, optimization is often restricted to local areas, e.g., to the vicinity of airports. Procedures around these areas stay unchanged, and effects from optimizations concerning ecological efficiency are not considered adequately. Investigating new concept elements, this typically results in local gain of efficiency without proving the global benefit.
The project World Wide Air Traffic Management (WW-ATM) creates a platform for optimization and validation of world-wide concepts considering feasibility, throughput, costs- and ecological efficiency, and robustness respectively fault liability. Based on different evaluation and optimization tools, complete traffic scenarios can be analyzed and improved both strategically and tactically.
This paper explains the WW-ATM concept and describes first steps in scenario generation. The project foresees three phases for the validation of future ATM concepts. First, a strategic planning is performed, based on flight demand data, weather forecast, and flight performance and emission models. The tactical phase simulates the execution of flights, including uncertainties and the simulation of failure events. Finally, the executed trajectories are evaluated in a third phase.
All three phases are supported by a set of evaluation tools, including 4D conflict detection, measurement of sector load, climate change function, online extraction of weather obstacles, compliance with airline preferences, and performance analysis for communication and navigation. Furthermore, the strategic planning and execution phase both are supported by several optimization tools reacting on the analyzed data. Thus, a network manager handles the flow of air traffic. The conflict resolution module solves identified conflicts, avoiding both surrounding traffic and severe weather areas. In addition, an airline decision tool realizes company specific preferences, a navigation module adapts required separation minima, and a communication module simulates the data exchange. Flights are also optimized individually for reduced emissions, flight time and climate change.
Besides defining the concept, one of the early tasks within the project is the generation of a world-wide air traffic scenario. The paper describes the creation of a realistic world-wide traffic scenario with more than 180,000 flights. Starting from departure/arrival airport pairs, weather data, aircraft types and departure times, an ARINC424-based navigation database tool generates realistic flightplans. Due to the large number of flights, the routing is performed by an A*-algorithm on a weighted graph containing the navigation data, requiring 10ms for single pathfinding on a standard PC on average. Feeding the predicted flightplans into a 4D-Flight-Management-System (FMS) produces 180,000 4D-trajectories. Resulting in more than 1.3 million conflicts, these trajectories constitute the base for upcoming WW-ATM simulation trials.



Alexander Kuenz finished his study of computer science in 2001. He holds a PhD from Leibniz-University Hanover since 2015. Since 2001 he is member of the department for pilot assistance at DLR Braunschweig as specialist for noise abatement procedures, air-ground integration, and conflict detection & resolution techniques. Since 2016, he is project manager for the WW-ATM (World Wide Air Traffic Management) project.